

3. AFFECTED ENVIRONMENT

This chapter describes the existing environment in and around the site of the proposed project at the Paducah Site. Information presented pertaining to the proposed transportation routes includes the total mileage (with a breakdown of rural, suburban, and urban miles) and the population density along the highway and rail transportation routes. Methods for determining impacts to the existing area are presented in Appendix C.

The Paducah Site is located within the Jackson Purchase region of western Kentucky in McCracken County, approximately 5.6 km (3.5 miles) south of the Ohio River and 32 km (20 miles) east of the confluence of the Ohio and Mississippi rivers. Even though disposal of USEC program wastes are not evaluated in this document, the following descriptions include all of the Paducah Site, including the portion of the plant that is leased to USEC.

3.1 LAND USE

The Paducah Site is located on a 3423-acre site owned by DOE. Most plant facilities (with the exception of landfills) lie within a fenced security area consisting of 749 acres. Surrounding the security area, DOE maintains a buffer zone of approximately 595 acres, which is used for support services, including the wastewater treatment plant (WWTP) and lagoons for plant water influx and efflux. The buffer zone also contains a construction/demolition debris landfill. The remaining 2079 acres are licensed to the Commonwealth of Kentucky for the purpose of wildlife management in the West Kentucky Wildlife Management Area (WKWMA). The Kentucky Department of Fish and Wildlife Resources (KDFWR) manages this area for the purpose of establishing or maintaining viable wildlife habitat. The property within the buffer zone is not licensed to the Commonwealth of Kentucky, although some is managed by KDFWR with the permission of DOE. DOE maintains the right to assume possession of any property within the buffer zone immediately, if deemed necessary.

The closest municipality to the Paducah Site is the city of Paducah, located approximately 16 km (10 miles) to the east. Several small communities are situated within an 8-km (5-mile) radius of the DOE property boundaries; these include Heath and Grahamville to the east and Kevil to the southwest. Metropolis, Illinois, is located north of the Paducah Site across the Ohio River. Bordering the DOE property to the northeast is the Shawnee Steam Plant, which is owned and operated by Tennessee Valley Authority (TVA). The area surrounding the Paducah Site is predominantly rural, with residences and farms scattered throughout the region.

3.2 GEOLOGY AND SEISMICITY

3.2.1 Geology

The near-surface geology at the Paducah Site, to a depth of approximately 30 m (100 ft), consists of clastic (made up of fragments) continental and marine deposits. The clastic continental deposits are represented by two sedimentary sequences from two distinct depositional periods. The younger clastic sequence, known as the Upper Continental Deposits (UCD), is a silt and clay lacustrine deposit with isolated sand and gravel lenses; it frequently contains perched water zones that comprise the Upper Continental Recharge System (UCRS).

The older clastic sequence, known as the Lower Continental Deposits (LCD), contains a 6- to 21-m (20- to 70-ft)-thick sand and gravel facies that forms the Regional Gravel Aquifer (RGA), which is the primary source of drinking water north of the Paducah Site. No residences in the immediate vicinity of the Paducah Site rely upon the RGA for groundwater supply, as most have been supplied with municipal water. No economic geological resources (e.g., mineral deposits) have been identified at the Paducah Site.

3.2.2 Seismicity

The Paducah Site is located in an area with a seismic risk rating of 3, the most severe rating on a scale of 1 to 3. Several minor seismic tremors have been recorded at the Paducah Site since the early 1950s; the largest, in 1962, measured 5.5 on the Richter scale. There has, however, never been a release of contaminants or structural failure at the Paducah Site as the result of seismic activity.

3.3 SOILS AND PRIME FARMLAND

3.3.1 Soils

The soils in the vicinity of the Paducah Site consist of silty loam and silty clay loam lying above the loess and alluvium surficial deposits. Six soil series are mapped in proximity to the Paducah Site (USDA 1976). These soil series include the Calloway silt loam, Grenada silt loam, Loring silt loam, Falaya-Collins silt loam, Vicksburg silt loam, and Henry silt loam. The Calloway-Henry association is the predominant soil association found in the vicinity of the Paducah Site. All but the Henry series can be considered prime farmland based on general soil properties.

Henry soils are nearly level, poorly drained soils with a fragipan (having a higher bulk density than the soil above, seemingly cemented when dry, but showing moderate to weak brittleness when moist) that formed in thick deposits of loess or alluvium. Henry soils have moderate permeability [from 1.6 to 5.08 cm/h (0.63 to 2.0 in./h)] above the fragipan, which forms between 43 and 66 cm (17 and 26 in.) from the surface, and slow permeability [<0.5 cm/h (<0.2 in./h)] within and below the fragipan. The water table is perched above the fragipan and extends to the surface during wet seasons (USDA 1976).

Calloway silt loam is somewhat poorly drained with a fragipan that formed in loess. These soils have moderate permeability [from 1.6 to 5.08 cm/h (0.63 to 2.0 in./h)] above the fragipan, which is between 66 and 127 cm (26 and 50 in.) below the surface, and slow permeability [<0.5 cm/h (<0.2 in./h)] within and below the fragipan. These soils have perched water tables that are from 15 to 46 cm (6 to 18 in.) below the surface during wet seasons. Slopes range from 0 to 6%.

Soils in the Grenada series are moderately well drained and were formed in loess on relatively smooth uplands and in alluvium washed mostly from loess on stream terraces. The depth to the fragipan ranges from 30 to 61 cm (12 to 24 in.), with an average depth of 36 cm (14 in.). The soil above the fragipan is moderately permeable [from 1.6 to 5.08 cm/h (0.63 to 2.0 in./h)], while the fragipan is relatively impermeable [<0.5 cm/h (<0.2 in./h)]. Soils below the fragipan have moderately slow permeability [from 0.5 to 1.6 cm/h (0.2 to 0.63 in./h)]. The water table is perched above the fragipan during wet periods.

The Vicksburg series consists of well-drained, nearly level soils on floodplains of branches and creeks. These soils formed in sediments washed mainly from loess. These soils have moderate permeability [from 1.6 to 5.08 cm/h (0.63 to 2.0 in./h)]. The water table is generally from 0.6 to 0.9 m (2 to 3 ft) below ground surface. Some soils are subject to flooding, but the floods are generally for short duration, and the erosion hazard is slight (USDA 1976).

3.3.2 Prime Farmland

Prime farmland, as defined by the U.S. Department of Agriculture Natural Resources Conservation Service, is land that is best suited for food, feed, forage, fiber, and oilseed production. It does not include “urban built-up land or water” (7 *CFR* 657 and 658). The Natural Resources Conservation Service determines prime farmland primarily on the basis of soil types found to exhibit desirable soil properties. These soil properties include soil quality, growing season, moisture supply, and other properties needed to produce sustained high yields of crops in an economical manner.

The following soil series, located in the vicinity of the Paducah Site, are considered to be representative of prime farmland: Calloway silt loam, Falaya-Collins silt loam, Grenada silt loam, Loring silt loam, and Vicksburg silt loam. These soil types are not likely to be found at the site. The soils at the site have been disturbed as a result of construction and maintenance activities at the Paducah Site since the early 1950s.

3.4 WATER RESOURCES AND WATER QUALITY

3.4.1 Water Resources

The Paducah Site is located in the western part of the Ohio River Basin. The confluence of the Ohio and Tennessee rivers is approximately 16 km (10 miles) upstream of the site. The confluence of the Ohio River with the Mississippi River is approximately 32 km (20 miles) downstream of the site.

The Paducah Site is located on a local drainage divide; surface flow is to the east and northeast toward Little Bayou Creek and to the west and northwest toward Bayou Creek. The confluence of the creeks is approximately 5 km (3 miles) north of the site. Little Bayou Creek originates in the WKWMA and flows north toward the Ohio River along a 10.5-km (6.5-mile) course through the eastern portion of the DOE reservation.

The 11,910-acre drainage basin of Bayou Creek is about twice that of Little Bayou Creek (approximately 6000 acres). During dry periods, natural runoff makes up the flow in Bayou and Little Bayou creeks.

Bayou Creek is a perennial stream; its drainage basin extends from approximately 4 km (2.5 miles) south of the Paducah Site to the Ohio River. Bayou Creek flows north toward the Ohio River along a 14-km (9-mile) course that passes along the western boundary of the site..

3.4.2 Water Quality

Kentucky Department of Environmental Protection (KDEP) has not formally classified Little Bayou Creek. According to state regulations [401 *Kentucky Administrative Regulations (KAR)* 5:026], however, any waters not specifically classified by KDEP are otherwise designated for the following uses: warm water aquatic habitat, primary contact recreation, secondary contact recreation, and domestic water supply; therefore Little Bayou Creek is classified for these uses by default. Little Bayou Creek receives point and nonpoint source effluent discharges from the Paducah Site, including process effluent, treated sewage, and storm water discharge under KPDES permit KY00040. The Paducah Site’s effluent discharges account for nearly all of the flow in Little Bayou Creek.

Bayou Creek receives effluent discharge from the Paducah Site, including process effluent, treated sewage, and storm water discharge under KPDES permit KY0004049 (October 22, 1986) and an Agreed Order with the Commonwealth of Kentucky (October 12, 1987). The most current KPDES permit became effective on April 1, 1998, and has an expiration date of March 31, 2003.

3.4.3 Groundwater

The uppermost aquifer in the Paducah Site area, the RGA, is developed in the lower gravel facies of the LCD. Recharge occurs as leakage from the UCD, including the UCRS. In general, flow in the RGA is to the north, to discharge into the Ohio River or alluvial deposits along the river. The predominantly fine-grained deposits of the McNairy Formation act as a basal confining layer for the RGA. Groundwater movement within the McNairy aquifer is north toward the Ohio River (DOE 2000c).

The UCRS is composed of heterogeneous silt and clay layers with interbedded or interlensed layers of sand and gravel. The distribution and depth of the sand and gravel layers determine the location of the water table within this recharge system. The discontinuous sandy horizons interbedded with finer-grained units result in perched groundwater throughout the UCRS.

Groundwater flow through the loess and clay-silt facies of the UCD is predominantly downward in the Paducah Site area. Seasonally saturated perched zones occur in the surficial soils above fragipans and in isolated sand lenses of the UCD. These sand lenses can produce only limited quantities of water during wet seasons. The limited extent of sands in the UCD offers little enhancement of pathways for pollution migration. Use of perched aquifers for water supply is unknown in the Paducah Site area but cannot be ruled out. Groundwater flow through the UCD is predominantly vertically downward rather than horizontally outward, and the sands are generally saturated only seasonally.

3.4.4 Floodplains

Flooding in the vicinity of the storage site and the proposed on-site treatment area would be caused by headwater flooding from Little Bayou Creek and would not be affected by backwater flooding from the Ohio River for a 500-year or lesser flood. The 100-year flood elevation for Little Bayou Creek ranges from about 108 to 110 m (355 to 360 ft) above mean sea level (MSL) about 1.6 km (1 mile) east of the site. The elevation of the nearest tributary to Little Bayou Creek is approximately 105 m (345 ft) above MSL. Ground surface elevations are approximately 111 m (365 ft) above MSL, which is well above the 100-year and 500-year flood elevations.

Headwater flooding from Bayou Creek could cause flooding in the vicinity of the storage site and would not be affected by backwater flooding from the Ohio River for a 500-year or lesser flood. The 100-year flood elevation for Bayou Creek ranges from about 111 to 111.5 m (365 to 366 ft) above MSL. The 500-year flood elevation ranges from about 111.5 to 112 m (366 to 367 ft) above MSL.

3.4.5 Wetlands

According to the U.S. Army Corps of Engineers (COE) Wetlands Investigation Report (COE 1994, Vol. IV), there are no wetlands within the boundaries of the storage site and the on-site treatment area. However, a small wetland of about 1 acre is mapped near the northwest corner of the site. As previously stated in the COE report, none of the potentially affected wetlands is of high ecological value in a regional context.

3.5 ECOLOGICAL RESOURCES

3.5.1 Vegetation

The DOE reservation at Paducah is a highly disturbed area. Vegetation communities are indicative of old-field succession (i.e., grassy fields, field scrub-shrub, and upland mixed hardwoods).

Open grassland areas managed by WKWMA are periodically mowed or burned to maintain early successional vegetation, which is dominated by members of the composite family and various grasses. Management practices of the WKWMA encourage re-establishment of once-common native grasses such as eastern gama grass (*Tripsacum dactyloids*) and Indian grass (*Sogastrum sp.*). Commonly cultivated for wildlife forage are corn, millet, milo, and soybean (CH2M HILL 1992). Field scrub-shrub communities consist of sun-tolerant woody species such as persimmon (*Diospyros virginiana*), maples (*Acer spp.*), black locust (*Robinia pseudoacacia*), sumac (*Rhus spp.*), scattered oaks (*Quercus spp.*), and mixed hardwood species (CH2M HILL 1992). The understory may vary depending on the location of the woodlands. Wooded areas near maintained grasslands may have an understory dominated by grasses. Other communities may contain a thick understory of shrubs, including sumac, pokeweed (*Phytolacca americana*), honeysuckle (*Lonicera japonica*), blackberry (*Rubus sp.*), and grape (*Vitis sp.*).

Upland mixed hardwoods contain a variety of upland and transitional species. Dominant species include oaks, shagbark and shellbark hickory (*Carya ovata*, *C. laciniosa*), and sugarberry (*Celtis laevigata*) (CH2M HILL 1992). The understory may vary from very open, with limited vegetation for more mature stands of trees, to dense undergrowth similar to those described for a scrub-shrub community.

3.5.2 Wildlife

This section describes the terrestrial (Sect. 3.5.2.1) and aquatic (Sect. 3.5.2.2) animals that have been observed at the Paducah Site and surrounding area.

3.5.2.1 Terrestrial Wildlife

Wildlife commonly found at the Paducah Site consists of species indigenous to open grassland, thickets, and forest habitats. Observations by ecologists during investigations at the site and information from WKWMA staff provided a qualitative description of wildlife likely to inhabit the vicinity of the site. The primary game species hunted for food in the area are deer (*Odocoileus virginianus*), turkey (*Meleagris gallopavo*), opossum (*Didelphis marsupialia*), rabbit (*Sylvilagus floridanus*), raccoon (*Procyon lotor*), and squirrel (*Sciurus spp.* and *Tamiasciurus hudsonicus*). Both game and nongame species are attracted to the area because of the intense habitat management program that has been implemented in the WKWMA (CH2M HILL 1991). Herpetofauna (amphibian and reptile), bird, and mammal species occurring at the Paducah Site are listed in tables in Appendix D of this report.

Small mammal surveys conducted on the WKWMA [Kentucky State Nature Preserves Commission (KSNPC) 1991] documented the presence of southern short-tailed shrew (*Blarina carolinensis*), prairie vole (*Microtus ochrogaster*), house mouse (*Mus musculus*), rice rat (*Oryzomys palustris*), and deer mouse (*Peromyscus sp.*). Larger mammals commonly present in the area include coyote (*Canis latrans*), eastern cottontail (*Sylvilagus floridanus*), opossum (*Didelphis marsupialis*), groundhog (*Marmota monax*), white-tailed deer (*Odocoileus virginianus*), raccoon (*Procyon lotor*), striped skunk (*Mephitis mephitis*), and gray squirrel (*Sciurus carolinensis*). Mist-netting activities in the Paducah Site area have captured red bat (*Lasiurus borealis*), little brown bat (*Myotis lucifugus*), Indiana bat (*Myotis sodalis*), northern long-eared bat (*Myotis septentrionalis*), evening bat (*Nycticeus humeralis*), and eastern pipistrelle (*Pipistrellus subfavs*).

Late spring roadside surveys conducted by Battelle (1978) reported 45 species of birds in the Paducah Site area, with northern bobwhite (*Colinus virginianus*), northern cardinal (*Cardinalis cardinalis*), indigo bunting (*Passerina cyanea*), common grackle (*Quiscalus quiscula*), eastern towhee (*Pipilo erythrophthalmus*), and European starling (*Sturnus vulgaris*) being the most abundant. Other common species include mourning dove (*Zenaidura macroura*), barn swallow (*Hirundo rustica*), blue jay (*Cyanocitta cristata*), common crow (*Corvus brachyrhynchos*), northern mockingbird (*Mimus polyglottos*), brown thrasher (*Toxostoma rufum*), common yellowthroat (*Geothlypis trichas*), eastern

meadowlark (*Sturnella magna*), and red-winged blackbird (*Agelaius phoeniceus*). The red-tailed hawk (*Buteo jamaicensis*) and American kestrel (*Falco sparverius*) were the most common raptors.

Several reptile and amphibian species are present in the vicinity of the Paducah Site. Herpetofauna documented by the KSNPC include cricket frogs (*Acris crepitans*), Fowler's toad (*Bufo woodhousii fowleri*), common snapping turtle (*Chelydra serpentina*), green treefrog (*Hyla cineria*), chorus frog (*Psuedacris triseriata*), southern leopard frog (*Rana ultricularia*), eastern fence lizard (*Sceloporus undulatus*), and red-eared slider (*Trachemys scripta elegans*) (KSNPC 1991).

3.5.2.2 Aquatic Wildlife

Streams. Semiannual surveys conducted by the ORNL Environmental Sciences Division (ESD) from 1992 through 1998 documented fish diversity in Bayou and Little Bayou creeks (Roy et al. 1996; Ryon and Carrico 1998; Kszos et al. 1997). A list of species occurring in both creeks during the ESD survey period is shown in Table I.4 of Appendix D. Over all surveys, Bayou and Little Bayou creeks yielded 51 and 39 species, respectively. Based on density, central stoneroller (*Camptostoma anomalum*) and longear sunfish (*Lepomis megalotis*) are the predominant fish inhabiting these streams. Four minnow species found in both creeks [common carp (*Cyprinus carpio*), red shiner (*Notropis lutrensis*), golden shiner (*Notemigonus crysoleucas*), and fathead minnow (*Pimephales promelas*)] and grass carp (*Ctenopharyngodon idellus*), collected in Bayou Creek, are not native to western Kentucky.

Slight differences in species composition between Bayou and Little Bayou creeks are probably attributable to differences in stream size and watershed area. More taxa were collected from Bayou Creek, which has an 11,910-acre catchment that is almost twice as large as the 6000-acre Little Bayou Creek catchment. Species that prefer large bodies of water—bowfin (*Amia calva*), river carpsucker (*Carpionodes carpio*), smallmouth buffalo (*Ictiobus bubalus*), bigmouth buffalo (*Ictiobus cyprinellus*), and black buffalo (*Ictiobus niger*)—were present in Bayou Creek but absent in Little Bayou Creek. Habitat conditions in Little Bayou Creek tend to favor mosquitofish (*Gambusia affinis*), blackspotted topminnow (*Fundulus olivaceus*), and green sunfish (*Lepomis cyanellus*) populations. Headwaters are more variable in flow regime and temporal habitat quality than are downstream areas; therefore, they favor species that are adapted either to consume a broader breadth of resources or to feed in a broader number of habitats. Mosquitofish and blackspotted topminnow, which both feed almost exclusively on insects at or near the surface, and green sunfish, a generalist omnivore, constitute a larger portion of communities in the upper reaches of Little Bayou Creek than at other sites in area streams.

Lakes and Ponds. Lentic habitats, including 13 ponds used for fishing, are located primarily in the WKWMA. No ponds are present within the Paducah Site security fence. Largemouth bass (*Micropterus salmoides*), bluegill (*Lepomis macrochirus*), and, to a lesser extent, green sunfish are the predominant species inhabiting ponds. Recently, contaminants were found in ponds located in the Kentucky Ordnance Works area, resulting in posting of warning signs. Little Bayou Creek also was previously fished; however, detection of elevated concentrations of PCBs in fish taken from Little Bayou Creek resulted in posting of consumption warnings. Amphibians, muskrat (*Ondatra zibethicus*), beaver (*Castor canadensis*), and many species of water birds, including wood duck (*Aix sponsa*), Canada goose (*Branta canadensis*), great blue heron (*Ardea herodias*), and green heron (*Butorides striatus*), use pond habitats and associated riparian areas. In addition to fishing ponds, there are many smaller ponds and abandoned gravel pits in the area that usually contain water and may support aquatic life.

3.5.3 Threatened and Endangered Species

Mussels including the orange-footed pimpleback (*Plethobasus cooperianus*), pink mucket pearly mussel (*Lampsilis arbrupta*), ring pink (*Obovaria retusa*), fat pocketbook (*Potamilis capax*), as well as

the Indiana bat (*Myotis sodalis*) are federally listed endangered species that may be found in or near McCracken County (COE1994).

The KDFWR conducted a mist net survey during the summer of 1999 on the WKWMA, which surrounds the Paducah Site. Five Indiana bats were captured during the survey (KDFWR 2000). The four mussel species have not been identified in water resources near the Paducah Site however they have been recorded between river miles 945 and 949 of the Ohio River, downstream from Metropolis, Illinois, and downstream of the confluence of Bayou Creek and the Ohio River (KSNPC 2000).

Indiana bats winter in caves, but during their reproductive season (usually from May 15 to August 15), the bats would form colonies in mature trees with loose bark, such as shagbark hickory, especially near water (CH2M HILL 1992). The range of the endangered Indiana bat is the eastern United States from Oklahoma, Iowa, and Wisconsin east to Vermont and south to northwestern Florida. Distribution is associated with major cave regions and areas north of cave regions. The present total population is estimated at ca. 352,000 with more than 85 percent hibernating at only nine locations - two caves and a mine in Missouri, three caves in Indiana, and three caves in Kentucky.

The orange-footed pearly mussel, a clam, is a federally listed endangered species that inhabits sand and gravel shoals and riffles. Current range of this species includes the Ohio River in reaches adjacent to Ohio, Indiana, Illinois, and Kentucky. It is a species associated with large rivers.

The federally endangered pink mucket pearly mussel (41 FR 24062; June 14, 1976) is a bivalve aquatic mollusk in the Unionidae family with an elliptical-shaped shell. The pink mucket is found in medium to large rivers. It seems to prefer larger rivers with moderate- to fast-flowing water, at depths from 0.5 to 8.0 m (1.6 to 26.2 ft). The species has been found in substrates including gravel, cobble, sand, or boulders. Currently, the pink mucket is known in 16 rivers and tributaries from 7 states, with the greatest concentrations in the Tennessee (Tennessee, Alabama) and Cumberland (Tennessee, Kentucky) rivers and in the Osage and Meramec rivers in Missouri. Smaller populations have been found in the Clinch River (Tennessee); Green River (Kentucky); Ohio River (Illinois); Kwanawha River (West Virginia); Big Black, Little Black, and Gasconde rivers (Missouri); and Current and Spring rivers (Arkansas).

The ring pink mussel was listed as an endangered species without critical habitat on September 29, 1989 (54 FR 40109). The U.S. Fish and Wildlife Service (FWS) (FWS 1991) formerly referred to this mussel as the golf stick pearly mussel. The ring pink mussel is one of the most endangered mussels because all of the known populations are apparently too old to reproduce. This mussel is characterized as a large-river species (FWS 1991). Historically, this mussel was widely distributed and found in several major tributaries of the Ohio River, including those that stretched into Alabama, Kentucky, Illinois, Indiana, Ohio, Pennsylvania, and West Virginia. However, the species was last taken in Pennsylvania in 1908, and in Ohio in 1938 (FWS 1991). According to records, this species has not been collected in Indiana in decades, and has not been collected from Illinois in over 30 years (FWS 1991).

The fat pocketbook mussel was listed as a federally endangered species in 1976 (41 FR 24064). The fat pocketbook mussel inhabits rivers and streams with sand, mud, or gravel substrates. It prefers slow-flowing water where depths range from a few inches to 8 ft. There are few published records on the historical distribution of this species for the period prior to 1970. Museum records indicated that most fat pocketbook occurrences were from three areas; the upper Mississippi River (above St. Louis, Missouri), the Wabash River in Indiana, and the St. Francis River in Arkansas. There are a few historic records of this species occurring in the Illinois River, but it has not been found in recent years (FWS 1989). Currently, the fat pocketbook in the mid-west is found only in the lower Wabash River in Indiana, the Ohio River adjacent to Kentucky, Indiana, and Illinois, and in the lower Cumberland River in Kentucky (FWS 1989).

The potential occurrence of federally and state-listed threatened and endangered species at the Paducah Site was determined by contacting the USFWS, KDFWR, and the KSNPC. Consultation letters describing the proposed action were submitted to the agencies requesting comments regarding potential effects of the proposed action. Copies of these letters and responses from the agencies are in Appendix E.

The consultation response from the FWS dated August 16, 2001, requested that a Biological Assessment be prepared for the Indiana bat and 4 mussel species. Preparation of the Biological Assessment determined that the project, as proposed, would be unlikely to adversely affect the Indiana bat or any mussel species of concern because:

- while a potential for exposure of the bat and mussel species to waste as a result of an accident during implementation of the proposed action would be small and there is nothing conclusive to indicate that such exposure would be detrimental to the species;
- proposed waste disposition activities are currently being performed at the Paducah Site with no known detriment to the local Indiana bat or mussel populations. The numbers of Indiana bats caught from mist netting in the area has risen from 1 in 1991 to 5 in 2000 and mussel species have been sampled on the opposite side of the Ohio River as recently as 2000; (KSMC 2000)
- no bat foraging or roosting habitat is present inside the site fence where waste disposition activities would occur. Potential habitats identified outside the site fence would not be affected by routine waste disposition activities;
- the majority of mussel habitat in the area has been identified up stream from the Paducah Site would not be affected by routine waste disposition operations; no mussel habitat exists inside the site fence and where waste disposition activities are proposed;
- bat foraging habitat (riparian vegetation along intermittent tributaries) present near the site of the proposed action is unlikely to become contaminated;
- routine waste management operating procedures would leave minimal opportunity for direct exposure of local biota and their prey, to wastes. This practice would also decrease the probability of accidents; and
- no bat or mussel habitat alteration or destruction would occur as a result of the proposed action.

A copy of the Final Biological Assessment in its entirety is included in Appendix F of this document.

There is no official listing of threatened or endangered species for the Commonwealth of Kentucky. A list of plant and animal species identified is maintained for monitoring purposes, by KSNPC (Table 3.1). There are currently no compliance requirements for these “state-listed” species.

Of the state-listed birds for the area [i.e., the endangered hooded merganser (*Lophodytes cucullatus*), the fish crow (*Corvus ossifragus*), and Bell’s vireo (*Vireo Bellii*)—all of which are species of special concern, only Bell’s vireo has been observed recently on the DOE reservation (CH2M HILL 1992). Commonwealth-listed mammals potentially occurring in the area include the evening bat (*Nycticeius humeralis*) and the northern long-eared bat (*Myotis septentrionalis*). None of the mammals has been observed on the DOE reservation. The KDFWR database lists the northern crawfish frog (*Rana areolata circumlosa*), a species of special concern, as occurring within the Heath quadrangle, which contains the Paducah Site (KSNPC 1991). Additional animal species noted by other investigators as occurring within the area, but not listed by KDFWR or KSNPC as occurring in McCracken County, include the lake chubsucker

(*Erimyzon sucetta*), a state-threatened species, and the great blue heron (*Ardea herodias*), a species of special concern. The lake chubsucker has been found in Bayou Creek (CH2M HILL 1991), and the great blue heron has been observed during site reconnaissance near KPDES Outfall 001 (CDM 1994) and in other plant industrial ponds. Commonwealth-listed animal species known from McCracken County are presented in Table 3.1; however, not all of these species are known from the vicinity of the Paducah Site.

Commonwealth-listed endangered and threatened plants that may occur in the area include the endangered Carolina silverbell (*Halesia carolina*) and the threatened compass plant (*Silphium laciniatum*). The Carolina silverbell occurs in moist or hydric areas often associated with floodplains or other low-lying areas in which water collects (KSNPC 1991). The compass plant occurs within open fields and sometimes along roadsides (KSNPC 1991). Commonwealth-listed plant species known from McCracken County are listed in Table 3.2; however, not all of these species are known from the vicinity of the Paducah Site. Commonwealth of Kentucky-listed species are not afforded any special protection but should be monitored, if possible, for location and abundance.

No commonwealth or federally listed plant species are known or are likely to occur within the Paducah Site security fence. Habitat at the proposed work site has been previously disturbed, is mowed on a regular basis, and is unlikely to support any of the aforementioned listed species. Because of the availability of suitable habitat at the Paducah Site, the following three Commonwealth of Kentucky-listed species might occur: (1) Bell's vireo (but this species has not been sighted near the Paducah Site recently), (2) the great blue heron (which has been observed), and (3) the Carolina silverbell, due to the moist woodlands on the site. Thorough evaluations, however, have not identified the Carolina silverbell at the site. Shagbark hickories and elms, known to occur in the wooded areas, may provide suitable habitat for the federally listed Indiana bat. Given the close proximity to industrial operations, it is unlikely that Indiana bats would select an area at the Paducah Site for colonization, especially when more suitable areas (i.e., more secluded and mature woodlands) are readily available in the vicinity.

Habitat for the Bachman's sparrow (*Aimophila aestivalis*), a federal candidate species, includes pasture, old-field habitat, short shrub or fencerow ecotones, or previously disturbed grassland areas. Such habitat does exist in the vicinity. No formal information exists related to sightings of this species in the vicinity of the proposed work areas; however, this species is not afforded any special protection, and Sect. 7 requirements of the Endangered Species Act do not apply.

3.5.4 Parks and Scenic Rivers

There are no state or national parks, forests, conservation areas, or scenic and wild rivers in the vicinity of the Paducah Site.

3.6 NOISE

Ambient noise levels are not measured at the Paducah Site or at any nearby facilities. There are currently no local ordinances concerning noise regulation. The Commonwealth of Kentucky has a law concerning noise regulation; however, no enforcement or monitoring program exists, and no regulations governing the implementation of this law have been promulgated.

Noise from industrial processes taking place at the plant is generally restricted to the interior of the plant buildings. Noise levels beyond the plant security fence are generally the result of vehicular traffic moving through the area.

Table 3.1. Commonwealth of Kentucky threatened, endangered, and “special concern” animal species known from McCracken County, Kentucky

Threatened species	Endangered species	“Special concern” species
<i>Erimyzon sucetta</i> (lake chubsucker)	<i>Acipenser fulvescens</i> (lake sturgeon)	<i>Ardea herodias</i> (great blue heron)
<i>Hyla avivoca</i> (bird voiced tree frog)	<i>Haliaeetus leucocephalus</i> * (bald eagle)	<i>Corvus ossifragus</i> (fish crow)
<i>Lepomis punctatus</i> (spotted sunfish)	<i>Hybognathus hayi</i> (cypress minnow)	<i>Esox niger</i> (chain pickerel)
<i>Lepomis minatus</i> (redspotted sunfish)	<i>Lampsilis abrupta</i> * [pink mucket (mussel)]	<i>Hyla cinerea</i> (green tree frog)
<i>Macrolemys temminckii</i> (alligator snapping turtle)	<i>Lepisosteus spatula</i> (alligator gar)	<i>Ichthyomyzon castaneus</i> (chestnut lamprey)
<i>Notropis maculatus</i> (taillight shiner)	<i>Lophodytes cucullatus</i> (hooded merganser)	<i>Ictiobis niger</i> [black buffalo (fish)]
<i>Nycticeius humeralis</i> (evening bat)	<i>Myotis sodalis</i> (Indiana bat)	<i>Lota lota</i> Burbot (fresh water cod)
	<i>Orconectes lancifer</i> (crayfish)	<i>Myotis septentrionalis</i> (northern long-ear bat)
	<i>Obovaria retusa</i> [rink pink (mussel)]	<i>Nerodia erythrogaster</i> (copperbelly water snake)
	<i>Plethobasus cooperianus</i> * [orange foot pimpleback (mussel)]	<i>Notropis venustus</i> (blacktail shiner)
	<i>Myotis austroriparius</i> (Southeastern bat)	<i>Noturus stigmosus</i> [northern madtom (fish)]
	<i>Potamilus capax</i> [fat pocketbook (mussel)]	<i>Rana areolata</i> (northern crawfish frog)
		<i>Riparia riparia</i> (bank swallow)
		<i>Vireo bellii</i> [bell’s vireo (bird)]

Table 3.2. Commonwealth of Kentucky threatened, endangered, and “special concern” plant species known from McCracken County, Kentucky

Threatened species	Endangered species	“Special concern” species
<i>Halesia carolina</i> (carolina silverbell)	<i>Hypericum adpressum</i> (creeping St. John’s-wort)	<i>Baptisia leucophaea</i> (cream wild indigo)
<i>Rudbeckia subtomentosa</i> (sweet coneflower)	<i>Prenanthes aspera</i> (rough rattlesnake-root)	<i>Carex triangularis</i> (fox sedge)
<i>Silphium laciniatum</i> (compass plant)		<i>Carya aquatica</i> (water hickory)
		<i>Heterotheca latifolia</i> (broad-leaf golden aster)
		<i>Lathyrus palustris</i> (vetchling peavine)
		<i>Malus angustifolia</i> (Southern crab apple)
		<i>Muhlenbergia glabriflora</i> (hair grass)
		<i>Solidago buckleyi</i> (buckley’s goldenrod)

3.7 CULTURAL, ARCHAEOLOGICAL, AND NATIVE AMERICAN RESOURCES

Inside a study area of about 12,000 acres in and around the Paducah Site, there are 35 sites of cultural significance recorded with the State Historic Preservation Officer and several more unrecorded sites (COE 1994). Most of these are prehistoric and located in the Ohio River floodplain. Six of the sites are on DOE property at the Paducah Site but are not within the site fence. None of the sites is included in, or has been nominated to, the National Register of Historic Places, even though some are potentially eligible. There are no identified Native American resources in the area.

3.8 CLIMATE AND AIR QUALITY

3.8.1 Climate

The Paducah area is located in the humid continental zone, characterized by warm summers and moderately cold winters. The annual temperature in the Paducah area averages about 14°C (57°F), with the highest monthly average temperature of 26°C (79°F) in July and the lowest of approximately 2°C (35°F) in January (DOE 2000b, 1999). Annual precipitation averages about 124 cm (49 in.) and is primarily in the form of rain. Data for the period 1985–1993 indicate that the average relative humidity is about 86% at 6 a.m. and about 58% at noon (DOE 1999a).

Average wind speed in the area is about 8.1 mph based on the most recent available data collected at the Barkley Regional Airport near Paducah for the period 1985–1992 (EPA 2000). As shown in [Fig. 3.1](#), dominant wind directions are from the south and south-southwest at an average wind speed of about 9.0 mph.

3.8.2 Air Quality and Applicable Regulations

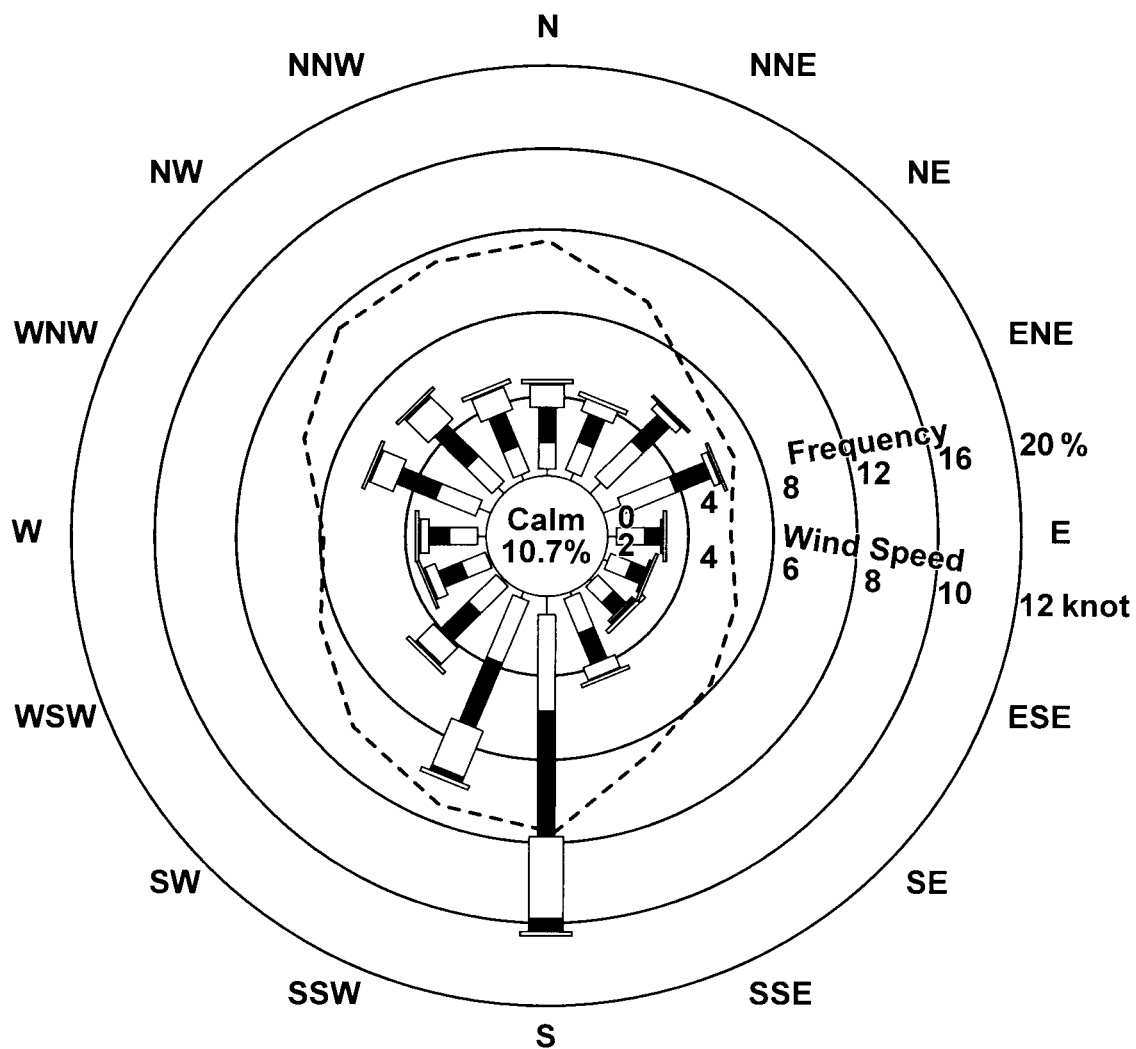
The Paducah area is located in the Paducah-Cairo Interstate Air Quality Control Region. The commonwealth's ambient air quality standards for six criteria of air pollutants—sulfur oxides as sulfur dioxide (SO₂), particulate matter with an aerodynamic diameter less than 10 µm (PM₁₀), carbon monoxide, ozone, nitrogen dioxide, and lead—are identical to the national ambient air quality standards (401 KAR 53:010). The primary ambient air quality standards, which are for the protection of public health, and the secondary ambient air quality standards, which are for the protection of welfare and the environment, are listed in [Table 3.3](#). In addition, the Commonwealth of Kentucky has promulgated ambient standards for hydrogen sulfide, gaseous and total fluorides, and odors. These standards also are shown in [Table 3.3](#).

Current air quality is good in the Paducah area. The area is designated as a Class II prevention of significant deterioration (PSD) area. New emission sources are not permitted to “notably” degrade air quality, with significance, defined in terms of maximum ambient air increments established for a Class II area (401 KAR 51:017). The nearest Class I PSD areas, where more stringent ambient air quality requirements must be met, are the Mingo National Wildlife Refuge in Missouri, approximately 145 km (90 miles) west of the Paducah Site, and Mammoth Cave National Park in Mammoth Cave, Kentucky, 217 km (135 miles) east of the Paducah Site (DOE 1999a).

3.8.3 Ambient Air Monitoring Near the Paducah Site

The ambient air quality is monitored regularly in the Paducah area and at the Paducah Site. Both the Commonwealth of Kentucky and USEC operate a monitoring network to determine ambient air concentrations of regulated pollutants. [Table 3.3](#) lists the highest background concentrations that can be considered representative of the Paducah area based on 1996 background data.

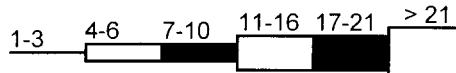
Paducah/WSO Airport, KY
(Period: 1985-1992)



**Directional Mean
Wind Speed**

**Mean Speed for
All Directions
< 7.0 knot >**

Wind Speed (knot)



57-122100-024

Fig. 3.1. Wind rose patterns of wind speed frequency and directional wind speed at the Barkley Airport.

Table 3.3. Commonwealth of Kentucky ambient air quality standards and highest background levels representative of the Paducah area*

Pollutant	Primary standard	Secondary standard	Highest background level
Sulfur oxides (sulfur dioxide) ($\mu\text{g}/\text{m}^3$)			
Annual arithmetic mean	80 (0.03 ppm)	—	13
Maximum 24-h average	365 (0.14 ppm)	—	55
Maximum 3-h average	—	1300 (0.50 ppm)	138
Particulate matter, measured as PM_{10} ($\mu\text{g}/\text{m}^3$)			
Annual arithmetic mean	50	50	24
Maximum 24-h average	150	150	83
Carbon monoxide (mg/m^3)			
Maximum 8-h average	10 (9 ppm)	Same as primary	4.9
Maximum 1-h average	40 (35 ppm)	Same as primary	6.9
Ozone ($\mu\text{g}/\text{m}^3$)			
Maximum 1-h average	235 (0.12 ppm)	Same as primary	182
Nitrogen dioxide ($\mu\text{g}/\text{m}^3$)			
Annual arithmetic mean	100 (0.05 ppm)	Same as primary	24
Lead ($\mu\text{g}/\text{m}^3$)			
Maximum arithmetic mean averaged over a calendar quarter	1.5	Same as primary	0.04
Hydrogen sulfide ($\mu\text{g}/\text{m}^3$)			
Maximum 1-h average	—	14 (0.01 ppm)	I
Gaseous fluorides, expressed as hydrogen fluoride ($\mu\text{g}/\text{m}^3$)			
Annual arithmetic mean	400 (0.5 ppm)	—	0.16
Maximum 1-month average	—	0.82 (1.00 ppb)	—
Maximum 1-week average	—	1.64 (2.00 ppb)	0.615
Maximum 24-h average	800 (1.0 ppm)	2.86 (3.50 ppb)	—
Maximum 12-h average	—	3.68 (4.50 ppb)	—
Total fluorides (ppm)			
Dry-weight basis (as fluoride ion) in and on forage for consumption by grazing ruminants. The following concentrations are not to be exceeded:			
• Average concentration of monthly samples over growing season (not to exceed six consecutive months)	—	40 (w/w)**	—
• 2-month average	—	60 (w/w)**	—
• 1-month average	—	80 (w/w)**	—

* Based on 1996 background data.

** w/w = weight/weight basis

The Paducah area, including the DOE Paducah Site, is currently an attainment area for all criteria pollutants. The largest air pollution sources near the Paducah area include USEC and TVA's coal-fired Shawnee Power Plant, approximately 5 km (3 miles) north-northeast of the Paducah Site. The Joppa Power Plant and the Allied Signal Metropolis Works Uranium Hexafluoride Conversion Plant are located across the Ohio River in Illinois; they are approximately 10 km (6 mi) northwest and 8 km (5 mi) northeast of the Paducah Site, respectively.

3.9 SOCIOECONOMICS AND ENVIRONMENTAL JUSTICE

3.9.1 Socioeconomics

The region of influence (ROI) for the socioeconomic impact analysis includes McCracken County, Kentucky, where the Paducah Site is located. Although surrounding counties also could be included, the assumption that all socioeconomic impacts would occur within the county identifies an upper bound on potential impacts. To the extent that any impacts spread to the surrounding counties, the relative effect on any one county would be smaller than those estimated here.

As of 1997, McCracken County's population totaled 64,773, with total employment of 45,879 and per capita income of \$24,231 (BEA 1999). DOE and USEC currently employ about 2200 individuals at the Paducah Site (BJC 2000).

3.9.2 Environmental Justice

For the purposes of this analysis, a minority population consists of any area in which minority representation is greater than the national average of 24.2%. Minorities include individuals classified by the U.S. Bureau of the Census as Negro/Black/African-American, Hispanic, Asian and Pacific Islander, American Indian, Eskimo, and Aleut. Since Hispanics may be of any race, nonwhite Hispanics are included in only the Hispanic category and not under their respective minority racial classifications. The demographics of the Paducah Site, with respect to income level and minority status, were evaluated in detail in the WM-PEIS (DOE 1997). Overall, the population within an 80-km (50-mile) radius of the Paducah Site does not contain a higher minority representation than the national average. While several census tracts to the north and southwest include minority populations above the national average, these locations are not near the Paducah Site (DOE 1999a).

Because any adverse health or environmental impacts are likely to fall most heavily on the individuals nearest the Paducah facility, it is also important to examine the populations in the closest census tracts. As of the 1990 census, none of the tracts closest to the site contained minority populations above the national average. The highest minority representation was 5.2% in tract 314 (McCracken County) (Bureau of the Census 1990a). No federally recognized Native American tribes are in the area.

The WM-PEIS did determine that a higher percentage of the population surrounding the Paducah Site qualified as low income than the national average. In this analysis, a low-income population includes any census tract in which the percentage of persons with incomes below the poverty level is greater than the national average of 13.1% (Bureau of the Census 1990b). Of the tracts closest to the site, 9701, 9703, and 9501 show percentages of low-income populations above the national average; approximately 17% of each of these populations is low income. Tracts 9701 and 9703 are directly across the Ohio River in Massac County, Illinois. Tract 9501 is west of the site in Ballard County (Bureau of the Census 1990a).

3.10 TRANSPORTATION

Interstate 24 passes through Paducah, Kentucky, approximately 16 km (10 miles) east of the Paducah Site. Four federal highways (US 45, 60, 62, and 68) and many state highways traverse the area. Main access to the plant is via US Highway 60. Because the Paducah Site is located in a secured area, traffic is minimal within the plant and surrounding area and generally is limited to trucks or service vehicles that move equipment and supplies within the facility. Rail access is available on-site at the Paducah Site.

3.10.1 Transportation Routes from the Paducah Site

Wastes are transported in approved DOT, NRC, and DOE containers that meet the requirements of the waste receiver (see Sect. 4.1.2 for assumptions relating to waste types and containers). The proposed action would adhere to these requirements. If LLW were transported by commercial truck, the waste would be transported along interstate highways or other primary highways well suited to cargo-truck transport. If waste were transported by rail, existing commercial rail routes and schedules would be used.

3.10.2 Truck Routes from the Paducah Site to Treatment and Disposal Sites

The highway route characteristics from the Paducah Site to the representative treatment and proposed disposal sites in the proposed action are provided in [Table 3.4](#). [Table 3.5](#) shows the population along the representative routes.

Table 3.4. Highway route distances from the Paducah Site to each proposed destination

Destination	Rural distance (miles)	Suburban distance (miles)	Urban distance (miles)	Total distance (miles)
Andrews, TX	943.4	171.7	11.9	1127.0
Deer Park, TX	711.5	171.9	13.5	897.0
Hanford, WA	1977.8	206.0	23.1	2207.0
Clive, UT	1497.7	163.8	29.5	1691.0
Mercury, NV	1648.2	187.1	25.0	1861.0
Oak Ridge, TN	252.5	54.8	2.7	310.0
Atomic City, ID	1594.9	175.6	20.4	1791.0

Source: Highway 3.4 code

Table 3.5. Potentially exposed populations along highway routes from the Paducah Site to each proposed destination

Route to	Potentially exposed population*
Andrews, TX	241,841
Deer Park, TX	236,130
Hanford, WA	353,676
Clive, UT	346,071
Mercury, NV	334,455
Oak Ridge, TN	56,958
Atomic City, ID	340,497

*Derived using population densities along highway links (source: Highway 3.4 code).

Representative highway transportation routes between the Paducah Site and proposed disposal destinations are outlined in [Figs. 3.2 through 3.7](#). Routes were selected using TRAGIS[®] software. A

comparison was performed between shortest-distance and shortest-time routes. Little difference was identified. Therefore, shortest distance routes were used for analysis.

The following constraints were applied in truck route selection:

1. avoidance of road segments prohibiting truck use,
2. following of HM-164/state-preferred routes for high-level radioactive waste,
3. avoidance of ferry crossings, and
4. avoidance of access roads between nonintersecting interstate highways.

Waste treatment may be conducted at the Paducah Site or at broad spectrum contractors. The route outlined in [Fig. 3.4](#) serves as a representative route to any of several commercial treatment facilities in the Oak Ridge, Tennessee area.

3.10.3 Rail Routes from the Paducah Site to Treatment and Disposal Sites

Representative rail routes between the Paducah Site and proposed disposal destinations are shown in [Figs. 3.8 through 3.13](#). The rail routes to Nevada, Texas, and Idaho do not terminate at the same location as the truck routes. However, the rail routes do end within the boundaries of the receiving sites.

[Table 3.6](#) provides the characteristics of the proposed rail routes. The total potentially exposed populations residing along the rail routes are estimated in [Table 3.7](#).

Table 3.6. Rail route distances from the Paducah Site to each proposed destination^a

Destination	Rural distance (miles)	Suburban distance (miles)	Urban distance (miles)	Total distance (miles)
Hobbs, NM	1064.4	216.5	27.7	1308.6
Strang, TX	1064.4	216.5	27.7	1308.6
Hanford, WA	1775.1	208.5	32.5	2016.1
Clive, UT	1575.4	187.9	31.5	1794.8
Las Vegas, NV	1956.8	189.6	34.3	2180.7
Oak Ridge, TN ^b	402.8	77.4	15.4	495.6
Scoville, ID	1679.2	178.1	28.6	1885.9

^aSource: Interline Data Network 15.0.

^bOak Ridge destinations (Oak Ridge National Laboratory, East Tennessee Technology Park, and Materials & Energy/Waste Control Specialists).

Table 3.7. Potentially exposed populations along railway routes from the Paducah Site to each proposed destination

Route to	Potentially exposed population^a
Hobbs, NM	380,284
Strang, TX	380,284
Hanford, WA	409,207
Clive, UT	381,473
Las Vegas, NV	413,971
Oak Ridge, TN ^b	168,524
Scoville, ID	342,689

^aDerived using population densities along railway links (Source: Interline Data Network 15.0).

^bOak Ridge destinations (Oak Ridge National Laboratory, East Tennessee Technology Park, and Materials & Energy/Waste Control Specialists).